Faculty of Electrical and Electronic Engineering Technology

DESIGN AN IOT BASED SMART AGRICULTURE USING ESP32

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Bachelor of Computer Engineering Technology (Computer Systems) with Honours

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A project report submitted
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I hereby declare that I have checked this project report. In my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Computer Engineering Technology (Computer Systems) with Honours.

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DEDICATION

I am dedicating this project to the Almighty Allah S.W.T, my creator, my inspiration, who has been the source of my strength throughout this year. Additionally, my dissertation is dedicated to the people close to me, including my loved ones and close friends. My heartfelt thanks go to my beautiful parents, Kamaludin Bin Mohammed Nor and Junaidah Binti Sidik, whose words of support and push for perseverance I will never forget. Thank you for your never-ending love and support, which keeps me determined and confident. My accomplishments and successes result from your supporters' faith in me. Thanks to my siblings, who keep me grounded and remind me of the essential things in life and constantly support my journey. I owe a debt of gratitude to my supervisor, Ts. Ahmad Fairuz Bin Muhammad Amin, for his excellent direction, assistance, inspiration, and excitement and enthusiasm for his work. Finally, I would like to express my gratitude to my dear friends and partner, who have always been there for me through thick and thin.

ABSTRACT

The Internet of Things (IoT) has been in use since 1999, and the demand for IoT continues to grow, whether from industries or society, to meet daily needs. Agriculture is one of the most critical sectors that our country need. Aside from sunlight and fertilization, water is the primary source of nutrition for plants in the agriculture sector. Even though water is an essential resource that the plant requires, farmers are likely to overwater the plant, resulting in water waste. Therefore, to use IoT as a remote control, especially in farming, a monitoring system was required, where farmers could track any changes in their fields using data from various sensors. This paper aims to create an intelligent agriculture system that will monitor and irrigate the yield by manual or automatic. However, creating this system will manage the water supply to the crops and monitor any changes found in the surrounding. The brain of this system is the NodeMCU ESP32 microcontroller that will connect with a temperature and humidity sensor, soil moisture sensor, relay, and DC motor. Blynk application will be used as a monitoring device where all the data received from the sensors will be sent to this application. The decision making can be made either by automatic or manually.

ABSTRAK

Internet of Things (IoT) telah digunakan sejak tahun 1999, dan permintaan untuk IoT terus berkembang, sama ada dari industri atau masyarakat, untuk memenuhi keperluan harian. Pertanian adalah salah satu sektor yang paling utama yang diperlukan oleh negara kita. Selain cahaya matahari dan baja, air adalah sumber utama pemakanan untuk tumbuh-tumbuhan dalam sektor pertanian. Walaupun air adalah sumber yang paling penting petani cenderung untuk menyiram tanaman mereka secara tidak terkawal. Oleh yang demikian, pembaziran air akan berlaku. Bagi menggunakan IoT sebagai alat kawalan jauh terutamanya dalam industri pertanian, sistem pemantauan sangat diperlukan di mana para petani boleh mengesan sebarang perubahan yang berlaku ke atas tanaman mereka melalui data yang diperolehi dari pelbagai sensor. Kertas kerja ini di tulis bagi tujuan mewujudkan sistem pertanian pintar yang akan memantau dan mengairkan tanaman secara manual atau automatik. Oleh itu, dengan wujudnya sistem ini ia akan menguruskan bekalan air ke tanaman dan memantau sebarang perubahan yang ditemui di sekelilingnya. NodeMCU ESP32 microcontroller bertindak sebagai otak yang akan berhubung dengan sensor suhu dan kelembapan, sensor kelembapan tanah, relay dan motor DC. Aplikasi Blynkakan bertindak sebagai peranti pemantauan di mana semua data yang di terima daripadasensor akan dihantar ke aplikasi ini dan keputusan boleh di buat sama ada secara manualatau automatik.

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CHAPTER 1

INTRODUCTION

1.1 Background

According to Juniper Research, over 13,4 billion devices were linked to the Internet as part of IoT in 2015, with that figure expected to grow by 185% to 38,5 billion by 2020[1]. According to the Malaysian Communication and Multimedia Commission, the percentage of Internet users reached 87.4% in 2018, increasing 10.5 percentage points from 76.9% in 2016. Around 28.7 million people used the Internet in 2017, up from 24.5 million in 2016 [2]. As a result, integrating a smartphone with an internet-based management system is suitable nowadays.

Agriculture is the art and science of growing plants and other crops, raising livestock for food, other human needs, or generating income. The agricultural sector's expansion is essential for the economy's growth, but sad to say. Many farmers continue to use conventional farming practices, which results in a low crop, fruit yield, and quality. Therefore, it needs to implement technologies in this industry to impact harvesting the fruits significantly.

On average, agriculture consumes 70% of worldwide freshwater withdrawals. In the previous 30 years, crop yield has expended more than 100%. FAO forecasts that roughly 60% more food would be needed by 2050 to fulfil a rising global population [3]. Therefore, an intelligent agriculture system needs to be designed to reduce the wasteful water user to resolve this problem. Smart agriculture is a system that manages, and monitors data collected via sensors. It is a management concept centered on providing agriculture with the infrastructure was necessary to harness advanced technology such as big data, the cloud, and the Internet of things (IoT) to measure, monitor, automate, and analyze operations. The intelligent agriculture system developed in this project will serve as a monitoring and irrigation system for the plants.

1.2 Problem Statement

Humanity and technology cannot be separated in the modern environment since they must fulfil anything. Therefore, we can reduce human workload by introducing a modern system in our daily lives, thanks to technological advancements in this century. Nowadays, we can see that every industry uses modern technologies to develop its system to perform at a high level, and the agriculture industry is no exception. Most individuals in the agriculture sector prefer to overwater their plants, leading to water waste. Therefore, to overcome this crisis, an innovative agricultural system may be implemented to fix this problem. By approaching this Internet of Thing technology, a system can be developed to monitor the moisture content of the soil, and an irrigation system may be created. Consequently, humans with extreme workloads no longer must be concerned about the status of their plants since they can check the plant's condition using a mobile phone. By adopting this technology, we can help farmers reduce energy and water.

1.3 Project Objective

This project aims to propose a systematic and practical methodology to estimate intelligent agricultural systems with an acceptable degree of accuracy. The goals are as follows:

a) To understand an IoT system based on intelligent agriculture.

b) To develop a monitoring system for the agriculture field based on IoT.

c) To create a mobile app that displays sensor data.

1.4 Scope of Project

This project develops smart agriculture consisting of several combinations of an electronic circuit and software implementation. This project aims to create a more desirable plant monitoring system and irrigation system in the agriculture industry with the help of some sensors and Internet of Things (IoT) technology. This project will collect the plant's data, including temperature, humidity, and moisture of the soil. If the humidity and wetness of the soil meet the requirements, this project will also provide water to the plant. The system can gather information about each sensor and send it to the mobile application so that the farmer non-essential monitor their plant manually. This project scope limits developing the system only for smallholder farmers because of the limitation device and eases to monitor their plant. Radial distribution network with balanced load condition.

1.5 Organization

This project aims to develop an intelligent agricultural system that can monitor and irrigate plants using a mobile application to track and control water delivery. There are five chapters in this report. The introduction, project objectives, problem statements, and project scope are covered in the first chapter. Following that, the second chapter will write literary studies that have been implemented from primary sources for reference. Next, the description of the component, software implementation, system flowchart, block diagram, and methodology used in this project will be discussed in Chapter 3. For chapter four, all the analysis carried out during the project development process includes data tabulation and explanation of the results. Finally, chapter five discusses the project's conclusions and future recommendations and improvements.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The purpose of this chapter is to review while researching previously completed projects involving smart agriculture and the Internet of Things. All the research is based on a study completed within the last five years of the project's implementation date; thus, it can be used as a reference. A comparison of hardware usage is also performed to select appropriate hardware to be used and all the benefits and drawbacks of hardware and systems to make a more accurate hardware selection. Finally, previous research results and methodologies will be examined and analyzed to ensure that they are the project's most reliable and valid reference source.

2.2 Related Work

2.2.1 NodeMCU ESP32

NodeMCU is an open-source firmware application written in the Lua programming language. Although the ESP8266E module is the most well-known NodeMCU, this project will use the ESP32 as a more capable NodeMCU. The ESP32 series of on-chip microcontrollers is a low-cost, low-power device with integrated WiFi and dual-mode Bluetooth. It is powered by a 32-bit LX6 microprocessor with a single core or dual-core configuration with a clock frequency of up to 240MHz [4]. Antenna switches, RF baluns, power amplifiers, low-noise acquisition amplifiers, filters, and strength-control modules are all included in the package.

The board has 520 KB of SRAM, 448 KB of ROM, and 16 KB of RTC SRAM. This gadget is more user-friendly because it can be configured in several ways. The ESP32 may be programmed in various environments, including the Arduino IDE, the PlatformIO IDE, LUA, MicroPython, Espressif IDF, and JavaScript.

Figure 2.1 NodeMCU ESP32[5]

2.2.2 GPIO

GPIO stands for general-purpose input-output. The ESP32 development board has 39 digital pins, and only 34 pins can be used as GPIO, and the rest are input pins only [6]. Each digitally activated GPIO may be programmed to operate as an internal pull-up or pull-down resistor or high-impedance resistor. It may also be programmed to create CPU interrupts through edge-trigger or level-trigger when set up as an input.

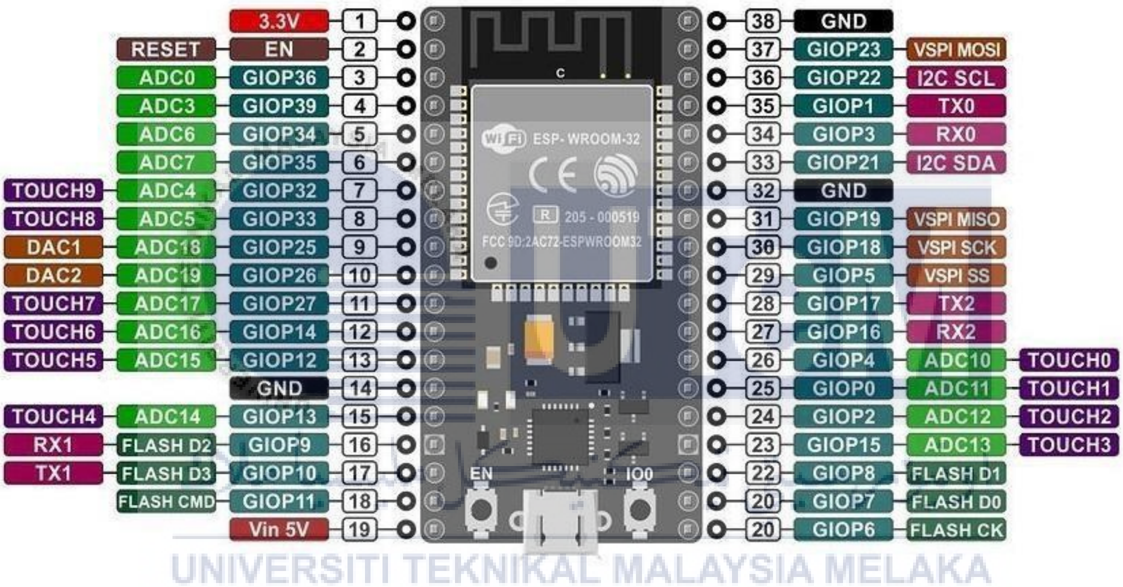

Figure 2.2 ESP32 Pinout [7]

2.3 Previous Project

2.3.1 An IoT Instrumented Smart Agriculture Monitoring and Irrigation System

Based on the project purpose by the author, this project aims to create an intelligent agricultural monitoring and irrigation system that allows farmers to monitor their crops using multiple irrigations and decision-making parameters [8]. The data from all the sensors will be sent to the ThingSpeak cloud platform, storing the data, and doing MATLAB analysis. The NodeMCU ESP8266 is the main microcontroller in this system, and it connects to all the sensors. The information from the soil moisture sensor is crucial because a soil moisture sensor is utilized to calculate the quantity of moisture present in the soil. The HC-SR501 PIR sensor detects movement of the body, whether human or animal, that crosses the sensor range. This system makes use of the Thingspeak IoT cloud, which allows users to set reactions and timers to deliver sensor data at specific intervals. Users need to write MATLAB code to create an interface using the IFTTT applet to send a notification on the mobile phone either in SMS or Email.

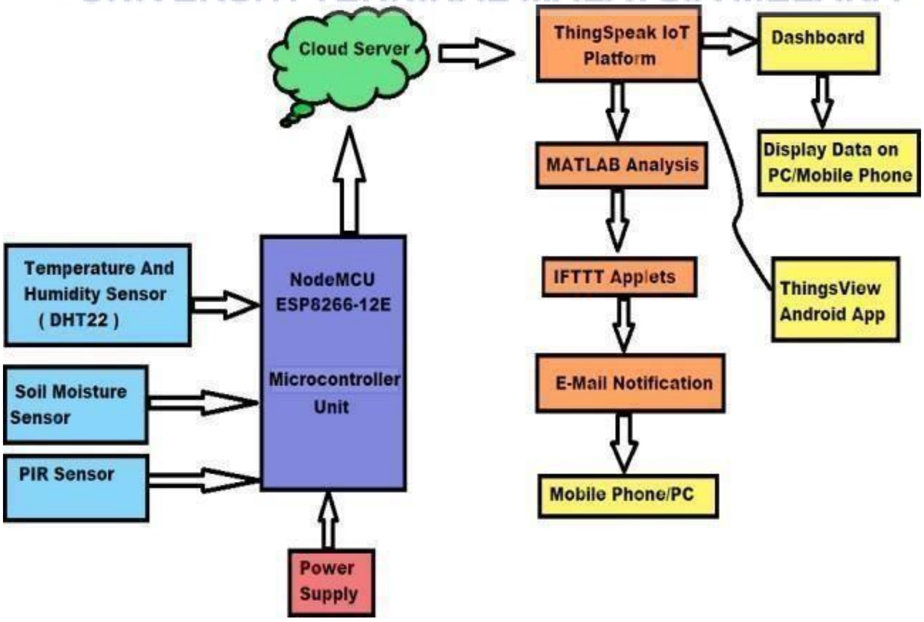

Figure 2.3 The architecture of one node of the Smart Irrigation System [8]

2.3.2 IoT based Low-Cost Smart Irrigation System.

Based on the proposal by [9], his project intends to implement smart irrigation in minimizing the percentage of water used for irrigation via the use of the Internet of Things (IoT). Sensors such as humidity, moisture, and ultrasonic deliver data to users to monitor the plant's soil moisture. The NodeMCU ESP8266 is used as a microcontroller to connect and gather data from all sensors. This system continuously monitors the weather, reservoir water levels, soil moisture levels, and supply water levels. If the moisture sensor detects insufficient water in the soil, the engine will begin pumping water from the reservoir. The ultrasonic sensor measures the percentage of water in the reservoir by sensing the water level from the top side. If the available water level in the reservoir falls below a predetermined threshold, messages will be broadcast through IoT protocol to web servers and mobile devices.

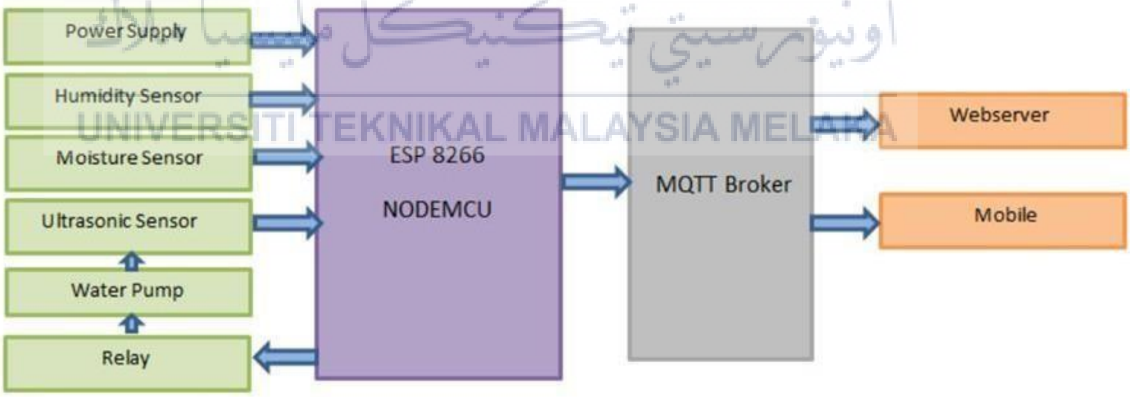

Figure 2.4 Purpose System Architecture [9]

2.3.3 IoT Based Smart Agriculture System

Based on this project [10] from the Department of ECE at Christ University in Bangalore, India. This project aims to create an intelligent agriculture system using cutting-edge technologies like Arduino, IoT, and wireless sensor networks. The article aims to combine upcoming technology like the Internet of Things (IoT) and smart agriculture with automation to achieve this objective. This system will be managed remotely by any smart device, and interface sensors and WiFi, actuators, and other hardware devices will be used to carry them out. The complete system was built utilizing infield sensors that collect data from the farm and send it to the base station via GPS. The necessary steps to control irrigation are decided.

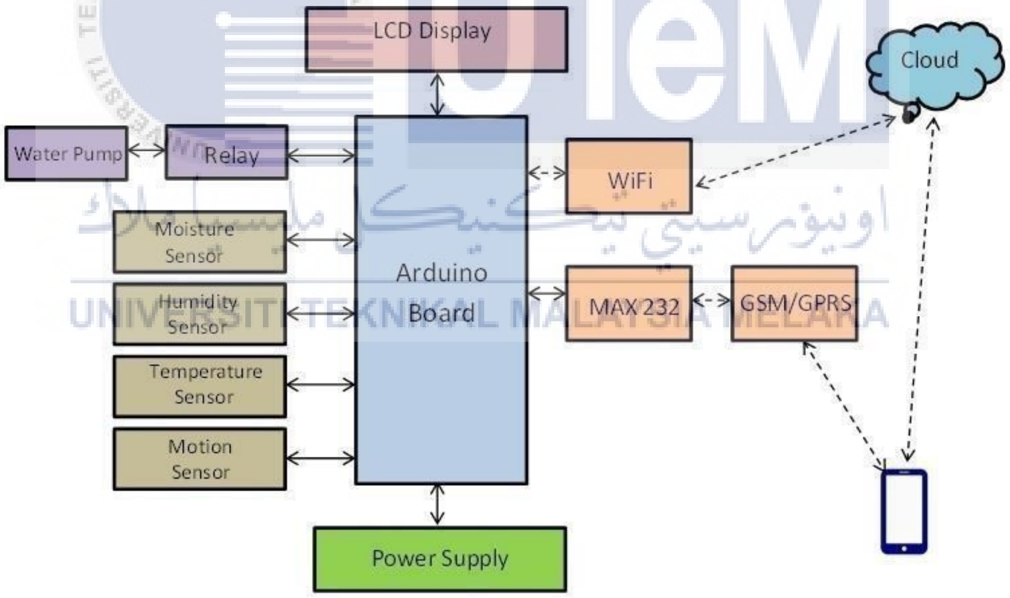

Figure 2.5 Block Diagram [10]